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Tetyana TESLENKO ©
Ph.D. (Economics), Associate Professor *(Dnipro Humanitarian University),* Ukraine

Bijay Kumar KANDEL ©
Ph.D. (Management) *(Kathmandu University, University of the South Pacific)*, Great Britain

THE CONTRADICTORY NATURE OF ICT AS A FACTOR OF DEVELOPING THE INFORMATION SOCIETY IN THE CONDITIONS OF THE FOURTH INDUSTRIAL REVOLUTION

Abstract. The relevance of the research on the problems of the Fourth Industrial Revolution is that Industry 4.0 is characterized by "a combination of technologies that blur the boundaries between the physical, digital and biological spheres" and represents a new revolution. The Fourth Industrial Revolution is based on the inventions of the Third, but its difference and main contribution lies in the combination of technologies that blur the boundaries between the physical, digital, and biological worlds. The purpose of the article is to conceptualize the contradictory nature of information and communication technologies (ICT) as a factor in the development of the information society in the conditions of the Fourth Industrial Revolution.

The task of the research is to reveal the contradictory influence of ICT on the development of digitalization; to trace the transformation of Internet technologies and their impact on the development of "digital twins"; to find out the main contradictory trends in the development of digitalization in the conditions of the Fourth Industrial Revolution. The object of the research is the contradictory nature of ICT as a factor in the development of the information society in the conditions of the Fourth Industrial Revolution. The subject of research is the influence of the Fourth Industrial Revolution on the contradictory nature of ICT as a factor in the development of the information society.

The authors use a system of methods and principles of scientific research – analysis and synthesis, abstraction, historical and logical, which allowed us to conceptualize the contradictory nature of ICT as a factor in the development of the information society in the conditions of the Fourth Industrial Revolution.

As research result, it has been proven that, on the one hand, there is a statement that digital technologies will provide solutions to most of today's economic and social problems, and on the other hand, scenarios prevail, according to which digital technologies will replace human labour, which will lead to a sharp increase in the level of unemployment with negative economic and social consequences. A digital twin, created by taking advantage of the improved technology, is an important method with its virtual reality infrastructure. A digital twin is used to analyze and simulate real-world conditions to respond to changes and improve processes. All this is further enhanced by technological advances in areas such as quantum

© Teslenko T., 2024
ORCID iD: https://orcid.org/0000-0002-5810-3569
c.spas.dp@i.ua

© Kandel B. K., 2024
ORCID iD: https://orcid.org/0000-0003-3793-2410
bijaykkandel@gmail.com

computing, machine learning and artificial intelligence, robotics, virtual assistants, the Internet of Things, self-driving cars and drones, 3D printing, nanotechnology, biotechnology, traffic and safety monitoring systems, renewable sources energy Therefore, we are trying to explain the process of information management, how it occurs, what it is based on, how modern trends in the development of "cyber-physical systems" connecting machines, computers and people are implemented. The assessment of the possibilities for creating new jobs through digitalization is contradictory. However, it is obvious that there will be significant opportunities in innovative IT services that require a high level of digital skills, and clusters around such services are already emerging in many countries. This means that digital technologies will be incorporated into projects related to health, education, agriculture, food security, basic infrastructure, water supply and sanitation, governance, social protection, financial services, etc. Digitalization is changing the economies of countries, but the specific scope and scale of these changes remain to be seen as they will be influenced by both technological development and political regulation.

Keywords*: information, information management, ICT, information society, Fourth Industrial Revolution.*

Introduction. The relevance of researching the problems of the Fourth Industrial Revolution is that Industry 4.0 is characterized by "a combination of technologies that blur the boundaries between the physical, digital and biological spheres" and represents a new revolution. It is different from the third one, which has a systemic impact of breakthroughs that do not have any historical precedent, and today, due to their complexity and contradictions, it shows a dualistic character, which has pros and cons. Industry 4.0 comes with huge obstacles in every sector of the economy, but the possibility of connecting billions of people, buying mobile devices with unprecedented power, and storage capacity with access to knowledge makes the revolution more special. According to Nick Bostrom, Industry 4.0 is characterized by new technological breakthroughs in artificial intelligence, robotics, the Internet of Things, autonomous vehicle Internet services, 3D printing, nanotechnology, materials science, energy storage, and quantum computing, which bring with them development strategies and dangers smart machines (Bostrom, 2020). Today, the world is at the dawn of a new 5th industrial revolution, which will fundamentally change the way we live and work. Peter Diamandis and Stevens Kotler (Diamandis & Kotler, 2021) note that while the Agricultural Revolution marked the transition of human societies from gatherers and hunters to settled farmers, the First Industrial Revolution, which began in the late 18th century, marked the transition from manual production to industrial production using machines (the steam engine is the most important one), mechanized production using the energy of water and steam, changing business, industry and our lives.

The last 230 years, known as the "Industrial Era", began with the use of steam engines in textile production and the introduction of the first mechanical loom in 1784. The introduction of electric power and mass production in 1870 marked the beginning of the Second Industrial (Technological) Revolution. The second industrial revolution at the turn of the 20th century introduced new technologies such as electricity and brought mass production using electricity, the basis of the development of Industry 2.0 was industrialization along with innovations. The introduction of assembly lines also marked the transition to the Second Industrial Revolution.

The third was already characterized by automation and Digitalization, mainly with the use of electronics and information technologies.

The Fourth Industrial Revolution is based on the inventions of the Third

one, but its difference and main contribution lies in the combination of technologies that blur the boundaries between the physical, digital, and biological worlds. Similarly, the digital revolution is seen as a transition from mechanical to digital technology and offers a range of new technological opportunities that have a profound impact on the economy as a whole. This is further enhanced by technological advances in areas such as quantum computing, machine learning, artificial intelligence, robotics, virtual assistants, the Internet of Things, self-driving cars, drones, 3D printing, nanotechnology, biotechnology, and traffic.

We try to trace the potential impact of the Fourth Industrial Revolution on information management and the role that information will play in all areas. The fourth industrial revolution is based on an analysis of the most common current trends and developments in "cyber-physical systems" that connect machines, computers, and people. The fourth industrial revolution considers the need to rethink the definition of information, its creation, types, processing, sustainability, and usability features. Given the magnitude of the potential impact of the Fourth Industrial Revolution on information management, the question is what challenges it poses to information managers. It can be assumed that it will be necessary to acquire new knowledge and skills and update existing processes and methods. Awareness of this new phenomenon is only the beginning and can be accompanied by professional development and appropriate training.

Analysis of recent research and publications. There is a lot of literature on Industry 4.0, referred to as the Fourth Industrial Revolution, especially its impact on the economy and education sectors. The interest in the topic of digitalization from the viewpoint of economic development is highlighted by a recent wave of publications and policy initiatives related to digitalization. Scholars have found that higher education in the context of the Fourth Industrial Revolution is a complex, dialectical, exciting opportunity that can change society. The digitalization literature suggests that AI is at the heart of the Fourth Industrial Revolution, which has the potential to transform workplace tasks from task-based to human-centric characteristics. Most of the new literature on the impact of digitalization focuses mainly on the analysis of industrialized countries, while the impact on developing countries has been underresearched.

However, there is reason to believe that a separate analysis of the impact on developing countries is needed since the effects of digitalization differ significantly depending on the level of industrialization and per capita income. The fact that in many developing countries the industrial revolution and the digital revolution are occurring simultaneously, creates certain challenges. It has been argued that China may have been one of the last countries to pass the wave of industrialization to prosperity, as already industrialized countries have significant advantages in the use of digital technologies. Although the recent literature focuses mainly on industrialized countries, there are several researches on the impact of pre-ICTs on development: the literature on ICT for development, the literature on big data (data for inventions), or big data for inventions. For example, UN agencies, development cooperation agencies, the World Bank, and others have collaborated to define the "Principles for Digital Development". Several

different development agencies have developed specific strategies and projects addressing the opportunities that digital technologies provide for development cooperation. The World Bank devotes annual reports to this topic: the "World Development Report" (World Bank 2016-2021), and the United Nations Conference on Trade and Development (UNCTAD) report "Digitalization, Trade and Development" (UNCTAD 2017-2021). According to Patrick Dixon (Dikson, 2021), scholars note similarities between perceptions of the ICT impact on developing countries in the late 1990^{s} and early 2000^{s} and during the new wave of digital technologies today.

Brian Christian and Tom Griffiths in the work "Life according to algorithms. How to make a rational choice" (Braian & Hriffits 2020) discuss some authors who have expressed concern that, in fact, the digital technologies used to solve problems create many new problems that, in turn, will require the formation of algorithmic culture and thinking.

Still there are few previously unsolved parts of the investigated problem. The history of industrial revolutions presents a historical scale that includes basic elements indicating the degree of complexity. The second half of the 20th century brought us computers and electronics, which for many meant the Third Industrial Revolution. Their mass distribution was caused by an increase in speed and functionality, as well as a decrease in price and size. Machines have become interconnected, able to "talk" to each other and perform many tasks that were previously had been reserved only for humans.

After the 1960^{s}, due to the growth of the urban population, people's socio-economic needs were diversified to get better government services and make life easier, and as a result, improve the world of computer and digital technology. As a result, the channels of communication have expanded along with the developments that have begun to develop rapidly in the digital world and affect all areas of human activity. The network of information exchange expanded, and the digital era began with Industry 4.0 in the early 2000^{s}. Today, this rapid integration, introduced by Industry 4.0, has shortened decision-making processes thanks to the instant insight into economic and financial data for enterprises. The interaction of objects, which are being developed together with the digital age, introduces radical digital transformations in many areas – from the procurement of services to delivery, which greatly affects efficiency, and needs to develop according to the modern requirements of the digital world.

For many industries, the introduction of cyber-physical systems marked the beginning of a new era – the Fourth Industrial Revolution, which is based on the Third one. The difference and its main contribution lie in the combination of technologies that blur the boundaries between the physical, digital, and biological worlds and gave rise to the phenomenon of "digital twins" in the era of the "second machine age, changing progress and prosperity" (Brynjolfsson & McAfee, 2016).

The purpose of the article is to research the nature of ICT as a factor of information societydevelopment in the conditions of the fourth industrial revolution.

Formulation of the main material.

1. The contradictory impact of ICT on the development of digitalization.

In recent years, the discourse on the digital revolution has attracted

interest both in the academic sphere and among politicians and the public. This interest is caused by the emergence of new technologies, such as various types of automation, robotics, artificial intelligence, and big data. However, the process of Digitalization of the economy is not a new phenomenon, it began in the second half of the 20th century (between the late 1950s and the 1970s, depending on the exact definition) with the advent of modern digital computing and continued with the emergence of various types of information and communication technologies (ICT), which influenced the IT giants and their intelligent machines that changed humanity, – Amy Webb notes in the work (Webb, 2020).

The digital revolution is often seen as the Third Industrial Revolution and is believed to have as profound an impact on the economy and society as the previous two industrial revolutions. Some even claim that the changes caused by digitalization will have a "destructive" nature and that there is a "possibility of completely new development trajectories", in particular the formation of a smart-society and smart-technologies (Voronkova et al., 2017). However, it is impossible to make accurate predictions about the economic and social consequences of such profound and unprecedented changes – the consequences for jobs and employment, structural transformations, environmental impacts, etc. Extreme views on both sides of the spectrum are widespread in public discourse. On the one hand, there is an assertion that digital technologies will provide solutions to most of today's economic and social problems, on the other hand, scenarios prevail, according to which digital technologies will replace human labour, which will lead to a sharp increase in the level of unemployment with negative economic and social consequences. One of the innovative technologies that has been introduced into our lives in recent years – digital twins – is revealed. A digital twin creates a copy of a physical object or process of real-time data obtained from the physical environment and prolongs it to the computer environment. It creates solutions using technologies such as machine learning, artificial intelligence and reconstructing the physical environment using these solutions.

Digitalization is a very broad and comprehensive concept; almost all economic processes are directly or indirectly affected by digital technologies, including our space future, – as Ashley Vance and Elon Musk claim in the work "Tesla, SpaceX and the Way to a Fantastic Future" (Vens & Mask, 2018). Scholars refer to the part of the economy that is directly related to digital technologies as the "digital sector", namely the IT/ICT sector that produces basic digital goods and services. The "digital economy" includes the "digital sector" plus digital services and platform services, which is defined as the part of the economic output generated solely or mainly by digital technologies with a business model based on digital goods or services.

The authors review measurements of what they define as the "digital economy" and estimate it to be around 5 % of global gross domestic product (GDP) and 3 % of global employment in recent years. This is about consistent with other research that finds approximately 6.5 %. There are estimates of the size of the entire "digital economy", according to which it was about 20 % of the global economy in 2015. However, due to measurement difficulties, the size of the "digital economy" is generally considered to be underestimated. Furthermore, there are significant global differences when it comes to the size

of the digital economy; the percentage of GDP for developing countries is likely to be about one-third to one-half of the Organization for Economic Co-operation and Development (OECD)/world figures. Given the high level of both complexity and uncertainty, the research focuses on a broad overview of the most important issues, as well as the relevance and state of application in development cooperation. Scientists start from the premise that the digital revolution will continue to occur and shape the economy and society. Therefore, the pressing question for politicians is not whether Digitalization should occur, but what type of Digitalization is desirable and how best to deal with it. This implies an answer to the question of how to use the potential and how best to mitigate possible negative consequences, creating a modern world, – Simon Winchester notes in the work (Winchester, 2019).

In recent years, the discourse on the digital revolution in the economy has gained renewed interest both in the academic sphere and among politicians and the public. This interest has been driven by the emergence of new technologies such as various types of automation, robotics, artificial intelligence, and big data. However, the process of digitalization of the economy (also known as Digitalization) is not a new phenomenon. It actually, began in the second half of the 20th century (between the late 1950^{s} and 1970^{s}, depending on the exact definition) with the advent of modern digital computing and continued with the advent of various types of information and communication technologies (ICT) during the last decades. The digital revolution is often seen as the Third Industrial Revolution and is expected to have as profound an impact on the economy and society as the previous two industrial revolutions (Voronkova, Teslenko et al., 2020).

It is necessary to emphasize nine principles of digital development: 1) "design with the user", which should take into account the specific target users of the technology with their interests and skills; 2) "understanding the existing ecosystem": the technology must be compatible with the local context and existing policies; 3) "design for scale": it is necessary to ensure the use of the technology after the pilot stage; 4) "creating for sustainable development": the goal should be to achieve a certain level of institutionalization in the applying of technologies so that they continue to be used in the future; 5) "data-driven": projects should be designed in such a way that data can be collected for decision-making and monitoring, and the data collected should be used for these purposes; 6) "using open standards, open data, open source codes and open innovation": if it is possible, to use open source technologies in order to avoid spending scarce development cooperation funds on expensive licenses and to reduce dependency on a particular supplier; 7) "reuse and improvement": it is possible to adapt technologies that are already used in a certain context, instead of introducing something completely new; 8) "privacy and security of an address": careful examination of what data is collected and received, used, stored and provided; 9) "to be collective": experience should be shared with other practitioners, users, experts.

Thus, K. Schwab suggests conducting a thorough impact assessment before implementing the technology, during which special attention should be paid to the following aspects: 1) to help avoid misuse by authoritarian governments or corporations with high market power and criminal forces; 2) to overcome inequality and the digital divide, which should decrease, but not

increase; 3) to support economic development that creates jobs; 4) to develop the ability of partners in conducting such assessments independently (Voronkova & Kyvliuk, 2017).

2. Transformation of Internet technologies and their influence on the development of "digital twins.

Science is like a wall rising above bricks. The development of technologies and their use in all areas of human life cause a transformation that is effective in many areas, such as human life, business processes, ways of doing business, distribution channels, social and cultural values, government processes, etc. (Voronkova, Punchenko & Azhazha 2020). This transformation brings both advantages and disadvantages, which affect many areas, which attests to the dualistic nature of information and communication technologies. The main purpose of the research is to draw society's attention to the consequences of changes in digital transformation, which makes a significant contribution to science and humanity, makes changes, and entails consequences that both people and the whole world face (Nikitenko, 2020).

Regarding digital twins mentioned above, it is necessary to emphasize that the technology of digital twins promises a great contribution and has advantages for many institutions and enterprises in both the public and private sectors in the context of the digital strategy, – Mark Goodman notes in the work "Crimes of the future: everything is interconnected, everyone is vulnerable and what we can do about it" (Goodman, 2019). Since it is impossible to understand and analyze the impact of digitalization on the quality of public life without a deep insight into achieving digitalization and its process, they are trying to prove the effectiveness and influence of digital twins along with the use of Internet technology objects. As a unique form of transformation of digital channels and services with the help of certain technologies, the digital twin attempts to focus on the transition from a traditional approach to an innovative one.

As a basic starting point, the digital twin highlights the transition to modern management and the digital twin method using continuous monitoring. This technology aims to try to find out the use and impact of the digital twin method, which is basically one of the advantages of technological developments, and their impact on real life. The Digital Twin attempts to make an important contribution to quality by ensuring the security of information technology and data through the ongoing state-of-the-art auditing offered by the Digital Twin. Technological advancements and digital transformation have opened the door to the digital age worldwide due to the desire and thirst for quick access to information. In the era of the Fourth Industrial Revolution, advances in areas such as artificial intelligence and machine learning, the Internet, and data analytics have been implemented during the transformation and development of technology to meet modern needs. Since the transition process is driven by innovation in many sectors, it quickly turns digital audit into an innovative structure that determines the transfer of human-created data or work processes in the digital environment, defining the digital strategy for the development of society, people, and business (Womack, Jones & Ross, 2017).

Digitalization with Industry 4.0 is the process of transforming resources into optimal results using the capabilities of digital technologies. European and

East Asian countries follow the innovations offered by digitalization and consider them as policies that can push the country forward in terms of technology, evaluating it within the framework of the national technological movement. It is argued that by increasing global competitiveness with the help of technology, economic and technological independence of countries will be achieved, social welfare will rise to a higher level, and digitalization will respond to human needs in the fastest way. Statistics show that while only 15 % of the global economy was digitized in 2005, and 22 % in 2015, in 2020 25 % of the global economy is digital. Thus, to be one of the leading countries in the world in terms of technology and to demonstrate successful growth, it is necessary to attach great importance to Digitalization and the general development index (GDI), which Richard Florida talked about. According to the theory of digitalization, the Fourth Industrial Revolution as a road map of intelligent manufacturing systems can surpass technological goals. Therefore, the concept of digital twins began to be perceived as an indicator of the power of the mind.

Among the innovative technological developments that are considered indicators of the power of the mind are innovations that can make human life easier, including big data analysis, virtualization, modelling and simulation, Internet platforms, innovative sensors, cloud computing, and cyber security. Increasing the speed of data processing on a computer in the era of digital technologies and the volume of data transformed innovative technological developments every day and gave rise to many new phenomena such as "digital twins" which modern civilization has not encountered yet. In particular, with increasing competition and global integration, all societies have transformed many different areas, ranging from portable storage, modelling, and data analysis to self-driving cars using sensors, – James P. Womack, Daniel T. Jones, Daniel Roos note (Womack, Jones & Ross, 2017).

A "digital twin" created by taking advantage of technology enhancements is an important method with its virtual reality infrastructure. The digital twin is used to analyze and simulate real-world conditions to respond to changes and improve the processes of an intelligent cloud platform based on services, applications, and algorithms, ensuring the privacy of extreme devices. They are based on the collection, processing, correlation, interpretation, reporting, and use of data for decision support systems, and implementation of applications and solutions in the field of cyber security. The intelligent cloud platform is based on the creation of a joint Internet program of safe and secure industrial facilities that can work together and in an integrated way, improving the development of software for devices and hardware, developing appropriate data storage technologies that are generated by reliable and innovative equipment and/or M2X (machine-human, machine-machine, machine-infrastructure) software. This improves the quality and efficiency of everyday life.

While technological inventions are building a bridge between the real and virtual worlds, the concept of digital twins is its generation and is closely related to technological phenomena such as design, data analytics, data mining, the Internet, deep and machine learning. With the help of digital twins, defects that may arise are noticed in advance, losses in terms of saving materials and time can be minimized by timely intervention. The number of solutions that are

achieved in response to problems can reach a maximum level, which can be easily solved by observing the problem on a virtual product before it is tested on a real product. Just as an information system creates a digital model for physical machines and can be implemented in a virtual environment, so a digital twin offers the possibility to check the quality of the process at each stage with a continuous audit. This is a kind of combination of artificial intelligence and virtual reality with phases such as constant monitoring and supervision of activities. To determine how objects work in different environmental conditions and how they react to the created responses, digital twins compare physical data with real results, in which fundamentals – force, principle, and technology – are inextricably laid.

3. The main contradictory trends in the development of digitalization in the conditions of the Fourth Industrial Revolution.

Information management in the Fourth Industrial Revolution connects billions of people through powerful communication networks and smart mobile devices, offering access to vast amounts of data and information through high-speed Internet access and unlimited memory. It affects a person's life, identity, and information management. All this is further enhanced by technological advances in areas such as quantum computing, machine learning and artificial intelligence, robotics, virtual assistants, the Internet of Things, self-driving cars and drones, 3D printing, nanotechnology, biotechnology, traffic and safety monitoring systems, renewable sources energy Therefore, we need to explain the process of information management, how it occurs, what it is based on, how modern trends in the development of "cyber-physical systems" that connect machines, computers and people are implemented. Information management includes the need to analyze and rethink the definition of information, its creation, types, processing, sustainability, and usability. Given the magnitude of the potential impact on information management, the question is what challenges are there in implementing information management today?

The research found that South Africa faces many challenges to fully digitize the education sector. The identified challenges include problems related to inequality, isolation, insufficient funding, insufficient skills, and the absence of a clear integrative national strategy, which indicates the insufficient development of ICT as a factor in the improvement of the information society. The research also found that, despite the challenges, the digital transformation of the education sector can provide an opportunity to ensure that universities will become innovative and creative centres, with the opportunity to expand access to educational resources. Big investments in the infrastructure of the Fourth Industrial Revolution can help to solve the problems of inequality and exclusion. National governments should develop an integrative national strategy to ensure that all regions and provinces move at the same pace during the transformation of this sector (Drucker, 2000).

However, despite the technology being integrated at an alarming rate into almost all sectors of our society, its ethical, pedagogical, and epistemological implications for the education sector remain questionable, especially concerning the challenges associated with full Digitalization. New technologies change the way of production and consumption of services, products, and materials, they opened the door for space expeditions, biotechnology, and

programmed specialists contribute to the development of high-level automation. Scientists claim that machines and humans will converge, which will reduce the subject distance between the humanities and social sciences, as the convergence between humans and machines will occur. Thanks to technological progress in Industry 4.0, enterprises are competing for innovations in products, services, and business models.

The research also showed that business sustainability can be achieved through the development of companies, and cooperation in supply chains. The success of the Fourth Industrial Revolution depends on the leadership of all sectors working together to seize the opportunities and address the challenges of the Fourth Industrial Revolution. Collaboration between its various participants is of decisive importance to ensure success, but for collaboration to happen, trust and cohesion are critical. It is important to find innovative ways to solve the socio-economic problems associated with the Fourth Industrial Revolution, such as potential job loss, increasing the wage gap, increasing digital skills, improving professional knowledge, which have a positive impact on the development of digitalization. Therefore, knowledge, practice, professional participation, and self-management can be considered the fundamental dimensions of readiness for digital work, – Ito Joy and Jeff Howe note in (Joy & Howe, 2018).

There are countless opportunities to take advantage of the innovations associated with the Fourth Industrial Revolution, and the framework conditions in which cooperation for development operates are evolving. Most research on the impact of digitalization on developing countries emphasizes that there is a significant "digital divide" in many countries, – Kai-Fu Lee says in the work "The superpowers of artificial intelligence" (Lee, 2020). The digital divide manifests itself in terms of inconsistencies: first, in the use of digital technologies (due to the presence of basic infrastructure, access, availability, etc.); second, in the benefits obtained from digital technologies; third, in the level of digital skills. The dimensions in which the digital divide exists include mainly development status (i.e. the gap in the use and return to technologies between industrialized and developing countries); urban against rural population; individual level of income and education within a certain country, forming human, social and intellectual capital, – Karlgaard Rich notes in the work "Human factor. The secrets of the long-term success of outstanding companies" (Rich, 2017).

This digital divide exists within all digital technologies and, in some dimensions, tends to widen. Although the majority of the world's population has access to mobile phones (5.2 billion) and can receive a mobile signal (7 billion), more than half of the world's population does not have access to the Internet. This "offline" population is located mainly in poor regions of the world. The relative size of the digital economy is about two to three times higher in industrialized countries than in developing countries. This digital divide attests to the sharp lag in the use of several different technologies in developing countries and least-developed countries. Except for mobile subscriptions – with over 70 % coverage of residents/households – all other technologies are used by at least four times as many residents/households in "advanced economies". As already mentioned, the Internet is still inaccessible to the majority of the world's population. In developing countries, there is a

significant gap between urban and rural populations, between education levels, income distribution, and genders (men are twice as likely to have access to the Internet as women of the same age group and with the same level of education and income).

The topic of the impact of ICT on the environment is extremely under-researched, especially with a particular emphasis on developing countries. There are three types of impact of ICT on the environment:

1) direct impacts are created by the production and use of ICT, which include resource use, energy consumption and pollution caused by the production of infrastructure and devices, electricity consumption from the use of devices, disposal of e-waste (which occurs mainly in developing countries);

2) indirect impact arises due to the influence of ICT on production processes, products, and distribution systems and includes dematerialization, the substitution effect, i.e. the replacement of material goods with informational goods, as well as travel with "communication technologies";

3) "structural and behavioural impact", which covers the effects caused by structural changes and growth of the economy, changes in lifestyles, and value systems with the help of ICT.

The overall impact of ICT on the environment is determined by the impact of all three categories. Thus, it is almost impossible to assess whether digital technologies will have an overall (negative or positive) impact on the environment. However, their environmental impact is significant and should be taken into account, as both mining and waste management are pressing issues for developing countries. Other authors emphasize the positive effects through which the technology contributes to increased efficiency and new opportunities for, for example, the production of renewable energy and the formation of technologies that shape our future (Kelly, 2018).

Industrialization, structural change, and employment, the emergence of a new wave of digital technologies has significant implications for both industrial development and employment. This changes both the relative importance of specific sectors in the economy and affects employment levels in those sectors as well as skill requirements. In recent decades, many developing countries have pursued "late-comer industrialization strategies", sometimes with success, as exemplified by the rapid industrialization of China and other Asian economies. However, there is growing evidence of a phenomenon called "premature deindustrialization" associated with digitalization, which has taken many companies to a new level, as Tim Cook notes in the work (Cook, 2019).

Empirical evidence shows that the process of deindustrialization observed in industrialized countries for decades occurs at earlier stages of industrial development than in newly industrialized countries. This means that the process begins at lower shares of industrial production in GDP and at lower income levels.

Scientists suggest that the economy of developing countries can become a service economy, without having passed the proper experience of industrialization, but in the last turn thanks to the growing "servicification" of industrial processes, the development of new digital technologies is promoted. At the same time, it means that the strategy of "late industrialization" that has been successful for many countries in the recent past may not be a viable development strategy for countries in the future. In addition, the issue of

employment and its replacement by technology is a serious concern, – Jeffery K. Liker says in (Liker, 2019). While digitalization is displacing some workers with technology, it is creating jobs in new fields. Both of these parameters must be taken into account to estimate overall changes in employment levels. The World Bank provides a framework for assessing the probability of automation by occupation. Many occupations at high risk of automation are also occupations that do not require a high level of technology use (e.g. agricultural workers).

This means that there is a tendency for a worker to be less likely to be replaced by technology if he/she complements the technology. However, there are also a few professions (mainly in the service sector) that do not require a high level of technology use and at the same time have a low risk of automation (for example, hairdresser). Regarding the country-level receptivity to automation according to development status, the results are very mixed. The World Bank suggests that industrialized countries are more susceptible to job losses due to digitalization than developing countries due to their high level of technology use. The analysis provided by Boston Consulting Group focuses on the potential of automation according to revenue. Most highly automated industries have a relatively high income, while most least automated industries have relatively low income, suggesting that industries in high (and middle) income countries will be more affected by automation than industries in low-income countries. It should also be said about the trend of negative correlation between income per capita and the share of employment with a high risk of automation: the lower the income per capita, the higher the risk of automation for the country's workforce, – Michio Kaku notes in his work (Kaku, 2017).

Assessing the possibilities of creating new jobs through digitalization is even more controversial. Nonetheless, it is clear that there will be significant opportunities in innovative IT services that require a high level of digital skills, and clusters around such services are already emerging in many countries. The tendency of future changes in the international division of labour and the organization of global production networks through digitalization is directly related to this issue. Since the 1970^{s}, there has been a continuous process of moving economic activity, in particular production, from industrialized countries to developing countries. There is now growing attention to the phenomenon of "reshoring" or "backshoring", which refers to the relocation of previously offshore economic transactions back to high-income countries, but this phenomenon is still understudied. Digitalization can facilitate repeat retention by changing cost structures and reducing the importance of economies of scale, although, today most manufacturing products are highly standardized and produced in large quantities, often far from the point of final demand, the new technological capabilities are likely to move production closer to final demand and in smaller quantities.

The most important technological capabilities in this regard have been summarized by the term "additive manufacturing". This refers to a development that can be understood as a change in specialization: new technologies allow a single worker or machine to efficiently produce parts, components, or even entire products that are made of different materials. The most striking example of "additive manufacturing" is 3D printing, when a machine can produce an entire product from an original material. Such

technologies allow for improved decentralized production in small quantities or even particular, personalized products for individual wants and needs. The speed and scale of reuse will depend on how quickly additive manufacturing moves from its current focus on prototyping and product development to decentralized mass production of final products from multiple materials. This, in turn, will depend on how quickly the costs of additive manufacturing, such as 3D printing, fall, determined by big data, which increases inequality and threatens democracy, – Kate O'Neill notes in (O'Neill, 2020). The observation is that digital technologies have received a very positive evaluation in the literature when we are talking about their potential for developing countries, and scholars express that there will be a tendency for revolutionary changes in the development of countries. The cycle of technology invention, hype around its development impact, collaborative learning through failed and successful project implementations, and finally more deliberate steps to integrate the new technology into the development effort are steadily evolving (Nikitenko, Andriukaitiene & Punchenko, 2020).

On the other hand, the new wave of digitalization differs significantly from the previous one in several dimensions, asserting that the new digital technologies in their overall impact are transformative in nature, end-to-end, and pervasive in their innovative application in various industries, and lead to the increasing homogeneity of industrial processes in functions ranging from design to monitoring and control methods. In addition, the "digital divide" between developing and industrialized countries has widened in various dimensions. The potential of ICT has been driven by the "shifts" brought about by technological change, contributing to the impact of technology on global productivity, expanding opportunities for the poor and middle class. However, digital technologies are fundamentally changing the global economy, and understanding these changes will be vital for development policy and development cooperation. Interest in the use of digital technologies in development projects has recently increased both, from the part of international organizations and development cooperation agencies, as well as private providers and non-governmental organizations. It should be noted that digital technologies can be applied in a large number of sectors where development cooperation is common, such as agriculture, trade, health, private sector development, etc. (Dahoho, 2021).

There are three trends in the implementation of digital technologies:

1) use of big data;

2) digital technologies for inclusive societies;

3) digital technologies for inclusive and sustainable economic growth.

To achieve these goals, digitalization can play an important role in all sectors, so digitalization is seen as an end-to-end challenge that suggests integrating digitalization into everything we do if it contributes to our vision. This means that digital technologies will be incorporated into projects related to health, education, agriculture, food security, basic infrastructure, water supply and sanitation, governance, social protection, financial services, etc. However, there are certain basic conditions for a successful "digital approach" that require close attention and include the availability of ICT infrastructure and electricity, the availability of human skills to use and manage the technology, sound leadership and an enabling regulatory framework. The

Belgian strategy emphasizes that local ownership and knowledge transfer, as well as environmental issues (the most important thing is e-waste management), are key to the sustainability of digital projects (Teslenko, 2021).

The main focus is on supporting the provision of digital infrastructure (e.g. broadband internet cable), e-learning projects, good governance and anti-corruption, public health projects, IT sector development, promotion of democratic processes, and refugee projects. Thus, the German agenda identifies changes in the labour market, the digital divide, data security, and human rights, as well as E-waste as the main challenges to digitalization (Teslenko & Zadoia, (2021).

Digitalization and technology are a strategic priority for Danish foreign and development policy, an area in which Denmark, based on digital values, principles, and experience with a highly digitized public sector, can help set global foreign and development policy agendas for the coming years.

Bridging the digital divide from the viewpoint of mobile phone and internet access is its main concern. Projects are being developed to use Blockchain technology in the context of development cooperation, such as financial transfers, record keeping (e.g., land ownership rights, medical records), contracting, e-voting, and e-learning. The UK's Department for International Development has launched a digital strategy that aims to establish it as a world leader in digital technology, tackle global poverty, promote common principles and standards for digital development across the care system, ensure safe internet access, use data to make decisions in the organization and to increase accountability (Teslenko, 2021, 2022).

Managing the economic potential and challenges of the digital economy includes both managing structural economic changes and harnessing the potential for new production and employment. In the context of digital development, the process of managing the changing skill needs in traditional labour-intensive light industries such as clothing, leather, agri-food, etc., in the light of automation and robotics (Industry 4.0) deserves special attention. It is concluded that economic feasibility rather than technical feasibility will be decisive, and that automation and robotics will ultimately reduce the potential for job creation in typically labour-intensive industries. Instead, the demand for work will shift to more qualified workers, the competitiveness of such industries will depend on the supply of qualified labour in the future. The state must increase investment in vocational training and education to equip the workforce with the skills needed for modern industrial production. This should include not only the necessary technical skills, but especially those skills that complement the type of tasks that will increasingly be performed by machines (Cherep, Voronkova et al., 2021).

Thus, the emergence of new job-creating economic activities will especially require the development of the tendency to develop the creative and innovative potential of the future workforce, which requires the following:

1) Development cooperation should support efforts to improve skills in industrial sectors, especially among the young working population.

2) Facilitating domestic production of high-value-added products: technologies such as 3D printing allow to produce of high-value-added products to order within the country (e.g. pharmaceuticals, prosthetics), thus avoiding the need for expensive imports of such products (Cherep,

Voronkova, et al., 2021).

3) Policymakers should promote companies using digital technologies to domestically produce products that replace expensive imports. Last but not least, digital technologies also offer new opportunities to improve the effectiveness of development cooperation by streamlining bureaucratic procedures and also improving the evidence base for designing and evaluating development projects.

Digital technologies can also contribute to increasing transparency of cooperation in the field of development. Ultimately, the economic, social, and political consequences of digitalization will depend on political governance, which will determine the strategic trajectories of the digital revolution in the future. It must be emphasized that this process must be based on democratic decision-making and, as far as development cooperation is concerned, aims to promote socially inclusive and environmentally sustainable development. All this requires effective information management, as the volume of information and the speed of change update, new elements of definition appear, focusing on quality, intellectual property, security, confidentiality, stability, the need for increased knowledge, and the achievement of stability (Cherep, Voronkova & Nykytenko, 2020).

Conclusions. Digitalization is changing the economies of countries, but the specific scope and scale of these changes remain to be seen because they will be influenced by both technological development and political regulation. Historical experience shows that technological euphoria, as well as overly pessimistic explanations of the transformational impact, are inappropriate. A first observation regarding impacts is that the large labour-displacing effects of Digitalization are not supported by available historical data. The introduction of new technologies has a dual impact on employment, although some jobs are lost, new jobs are created due to the emergence of new activities and new products and services that are made possible by new technologies (Cherep, Voronkova, Andriukaitiene & Nikitenko, 2020).

Thus, the real policy challenge consists of two parts: 1) coping with the inevitable migration of jobs from old sectors and industries to new ones; 2) stimulating the emergence and expansion of new economic sectors that use and expand new technologies in such a way as to provide a net social benefit to society. The first challenge especially requires government capacity in the field of education and vocational training, as well as an active labour market policy.

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and expand new technologies in such a way as to provide a net social benefit to society. The first challenge especially requires government capacity in the field of education and vocational training, as well as an active labour market policy. The second challenge requires a proactive industrial policy focusing on innovation, tax and financial pinfluenceolicy, infrastructure policy, and social and regulatory policy. Perhaps such political capacity is better developed in highly industrialized countries than in developing countries, and development cooperation should support building its digital capacity.

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Conflict of Interest and other Ethics Statements
The authors declare no conflict of interest.

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Тетяна ТЕСЛЕНКО, Біджай Кумар КАНДЕЛ

СУПЕРЕЧЛИВА ПРИРОДА ІКТ ЯК ЧИННИК РОЗВИТКУ ІНФОРМАЦІЙНОГО СУСПІЛЬСТВА В УМОВАХ ЧЕТВЕРТОЇ ПРОМИСЛОВОЇ РЕВОЛЮЦІЇ

Анотація. Актуальність дослідження проблем Четвертої промислової революції в тому, що індустрія 4.0 характеризується «поєднанням технологій, які стирають межі між фізичною, цифровою та біологічною сферами» і представляють нову революцію. Четверта промислова революція базується на винаходах Третьої, але їх відмінність і головний внесок полягає у поєднанні технологій, які стирають межі між фізичним, цифровим і біологічним світами. Мета статті – концептуалізація суперечливої природи ІКТ як чинника розвитку інформаційного суспільства в умовах Четвертої промислової революції. Завдання дослідження: розкрити суперечливий вплив ІКТ на розвиток цифровізації; прослідкувати трансформацію Інтернет-технологій та їх вплив на розвиток «цифрових двійників»; з'ясувати основні суперечливі тенденції розвитку цифровізації в умовах Четвертої промислової революції. Об'єктом дослідження є суперечлива природа ІКТ як чинник розвитку інформаційного суспільства в умовах Четвертої промислової революції. Предметом дослідження – вплив Четвертої промислової революції на суперечливу природу ІКТ як чинник розвитку інформаційного суспільства. Використано систему методів та принципів наукового дослідження - аналізу і синтезу, абстрагування, історичного і логічного, що дозволили Здійснити концептуалізацію суперечливої природи ІКТ як чинника розвитку інформаційного суспільства в умовах Четвертої промислової революції.

Як результат дослідження доведено, що з одного боку, існує твердження, що цифрові технології забезпечать вирішення більшості сучасних економічних і соціальних проблем, а з іншого, переважають сценарії, згідно з якими цифрові технології замінять людську працю, що призведе до різкого зростання рівня безробіття з негативними економічними та соціальними наслідками. Цифровий двійник створений за допомогою переваг вдосконалення технології, є важливим методом з його інфраструктурою віртуальної реальності. Цифровий двійник використовується для аналізу та моделювання умов реального світу, щоб реагувати на зміни та вдосконалювати процеси. Все це додатково посилюється прогресом технологій у таких сферах, як квантові обчислення, машинне навчання та штучний інтелект, робототехніка, віртуальні помічники, Інтернет речей, безпілотні автомобілі та дрони, 3D друк, нанотехнології, біотехнології, системи моніторингу руху та безпеки, відновлювані джерела енергії. Тому ми намагаємося пояснити процес управління інформацією, як він відбувається, на чому

базується, як реалізуються сучасні тенденції розвитку «кіберфізичних систем», які з'єднують машини, комп'ютери та людей. Оцінка можливостей створення нових робочих місць шляхом цифровізації носить суперечливий характер. Проте, очевидно, що з'являться значні можливості в інноваційних ІТ-сервісах, які вимагають високого рівня цифрових навичок, кластери навколо таких послуг уже виникають у багатьох країнах. Це означає, що цифрові технології будуть включені у проєкти, пов'язані з охороною здоров'я, освітою, сільським господарством, продовольчою безпекою, базовою інфраструктурою, водопостачанням і санітарією, управлінням, соціальним захистом, фінансовими послугами тощо. Цифровізація змінює економіку країн, проте конкретний обсяг і масштаб цих змін ще належить з'ясувати, так як на них впливатимуть як технологічний розвиток, так і політичне регулювання.

***Ключові слова**: інформація, управління інформацією, ІКТ, інформаційне суспільство, Четверта промислова революція.*

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Artur MARHULOV ©
D. Sc. in History,
Associate Professor
(Dnipropetrovsk State University of Internal Affairs), Ukraine

COLLABORATIONISM IN THE UKRAINIAN DIMENSION: EVOLUTION OF UKRAINIAN STATEHOOD

Abstract. The russian-Ukrainian war has brought renewed attention to the modern interpretation of terminology associated with military conflict. One such term is "collaborator" and "collaboration." Their appearance is linked to the course of the Second World War, but in modern times, they have acquired specific features. The hybrid nature of the military-political activities of the russian federation in Ukraine has led to a deformation of the meanings of established concepts and terms. Presenting its aggressive policy as an internal conflict, russia initially prevented the legal classification of collaboration as a violation of the law.

The article discusses the motivational component of the population in certain regions of the Donetsk and Luhansk oblasts in supporting actions related to the occupation of these territories. The formation of privilege in these regions during Soviet times led to a distorted system of values and orientations in the population of the region. Representatives of the regional industrial-state oligarchy tried to preserve this mental worldview in the evolution of the economy from a state to a market economy. It is characteristic that political forces channeled this regional mental specificity into electoral bonuses for themselves on the way to elections to government bodies. By acting as a passive manipulative component of the population, the region gradually adapted to aggressively protest against existing formats of state power.

© Marhulov A., 2024
ORCID iD: https://orcid.org/0000-0001-9543-540x
margulov@gmail.com